National Aeronautics and Space Administration

NASA Advisory Council Aeronautics Committee Report

Ms. Marion Blakey, *Chair*

April 16, 2014
NASA Headquarters

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Committee information

Members

- Ms. Marion Blakey, Chair (Aerospace Industries Association)
- Mr. John Borghese (Rockwell Collins)
- Dr. Karen Thole (Penn State University)*
- Dr. John Langford (Aurora Flight Sciences)
- Mr. Mark Anderson (Boeing)
- Dr. John-Paul Clarke (Georgia Institute of Technology)
- Dr. Mike Francis (UTRC)
- Dr. Mike Bragg (University of Illinois)
- Mr. Tommie Wood (Bell Helicopter)
- Gen. Les Lyles (ASEB, ex-officio member)

Plans for next meeting: July 2014.

* Participated remotely

Areas of interest explored at current meeting

Topics covered at the Aeronautics Committee meeting held on March 27-28, 2014 at NASA Headquarters:

- CY 2014 Work Plan
- Aeronautics FY15 President’s Budget*
- ARMD Program Reorganization*
- System-Wide Safety Assurance Thrust Overview
- Foundational Technologies
- Transformative Aeronautics Concepts Program
- Unmanned Aircraft Systems (UAS) Traffic Management*
- University Engagement

*These topics have related recommendations or findings by the Aeronautics Committee

CY 2014 work plan

1. Review ARMD reorganization portfolio, specifically the newly formed Transformative Aeronautics Concepts Program. Provide feedback on TAC vision, research content, and planning process.
2. Review planning and initial activities of the Advanced Composites Project. The Committee will assess their project plan and advise on areas of improvement.
3. Review study outcomes from the National Research Council-led Autonomy study and, if applicable, recommend follow on ARMD activities.
4. Review and provide feedback on the ARMD Strategic Implementation Plan. The Committee will provide comments on outcomes and technical challenges that ARMD is investing in.
5. Review the Fundamental Aeronautics Program foundational tools and technologies research portfolio including relevance to industry. The Committee will provide feedback on research content capability improvements.
6. Review the outcomes, research themes, and technical challenges associated with the "Transition to Low-Carbon Propulsion" strategic thrust. The Committee will provide guidance on ARMD strategies in this area and advise on any research content improvements or gaps.
7. Review the outcomes, research themes, and technical challenges associated with the "Enable Real-Time System-Wide Safety Assurance" strategic thrust. The Committee will provide guidance on ARMD strategies in this area and advise on any research content improvements or gaps. In particular, the Committee will look at the ARMD approach to developing verification and validation methodologies for enabling quicker certifications.

Aeronautics FY15 President's budget

Current funding will shift into four different program buckets if the FY15 budget is enacted.

Aeronautics Research Mission Directorate

$M

($ Millions)

AERONAUTICS	FY 2013 Op Plan	FY 2014 Op Plan	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
	$529.5	**$566.0**	**$551.1**	**$556.6**	**$562.2**	**$567.8**	**$573.5**
Airspace Operations and Safety			131.0	132.7	134.6	135.9	137.3
Advanced Air Vehicles			213.6	211.4	205.8	203.3	205.3
Integrated Aviation Systems			127.0	125.8	128.0	133.4	134.8
Transformative Aeronautics Concepts			79.5	86.8	93.8	95.2	96.2
Aviation Safety	77.6	80.0					
Airspace Systems	89.8	91.8					
Fundamental Aeronautics	167.7	168.0					
Aeronautics Test	74.6	77.0					
Integrated Systems Research	99.0	126.5					
Aeronautics Strategy and Mangt.	21.0	22.7					

Note: As reflected in the August 2013 Operating Plan, FY 2013 includes rescissions per P.L.113-6 Division G, Section 3001(b)(1)(B) and Division G, Section 3004(c)(1) and reductions due to sequestration per BBEDCA Section 215A.

FY 2014 reflects funding amounts specified in P.L. 113-76, Consolidated Appropriations Act, 2014.

What’s at the center of the reorganization?

The Promotion of Innovation and Convergent Research.

Goal 1: Pursue Innovative Solutions Aligned to the Strategic Thrusts

Enable programs to clearly define most compelling technical challenges and retire them in a timeframe that is supportable by stakeholders and is required by our customers.

Goal 2: Incentivize Multi-Disciplinary “Convergent” Research

Establish a flexible and organic environment to allow for the development of high-risk, leap-frog ideas to address “big problems.” This will allow rapid demonstration of feasibility with high turnover rates, conducted in a convergent, multi-disciplinary, integrated manner.

Goal 3: Enable Greater Workforce and Institutional Agility and Flexibility

- Enable more flexibility to embed flight research throughout research phases and bring back X-plane culture.
- Enable more agile research practices that combine high-fidelity simulation, ground testing, and flight research.

Aeronautics programs

All of the new programs address more than one, or all, of the research thrusts.

MISSION PROGRAMS

Airspace Operations and Safety Program

AOSP

Develops and explores fundamental concepts, algorithms, and technologies to increase throughput and efficiency of the National Airspace System safely.

Supports three strategic thrusts

Advanced Air Vehicles Program

AAVP

Conducts fundamental research to improve aircraft performance and minimize environmental impacts from different types of air vehicles

Supports four strategic thrusts

Integrated Aviation Systems Program

IASP

Flight research-oriented, integrated, system-level R&T that supports all six thrusts

X-planes/ test environment

SEEDLING PROGRAM

Transformative Aeronautics Concepts Program

TACP

High-risk, leap-frog ideas that support all six thrusts

Critical cross-cutting tool development

Our strategic thrusts

Informed by three mega-drivers, ARMD’s research is being aligned under six strategic research and technology thrusts.

Safe, Efficient Growth in Global Operations

- Enable full NextGen and develop technologies to substantially reduce aircraft safety risks

Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard

Ultra-Efficient Commercial Vehicles

- Pioneer technologies for big leaps in efficiency and environmental performance

Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology

Real-Time System-Wide Safety Assurance

- Develop an integrated prototype of a real-time safety monitoring and assurance system

Assured Autonomy for Aviation Transformation

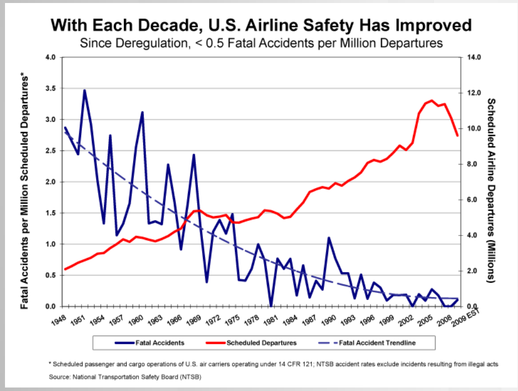
- Develop high impact aviation autonomy applications

Real-time system-wide safety assurance

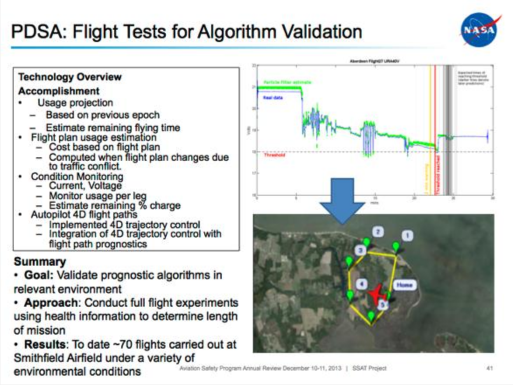
Real-Time System-Wide Safety Assurance

- Pioneering Methods and Integration for Real-Time System-Wide Safety Monitoring and Assurance

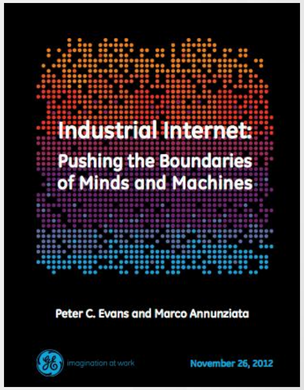
Achieve a New Level of Safety Performance and Enhance Safety Management Agility/Flexibility to Accommodate Greater Aviation System Creativity and Innovation

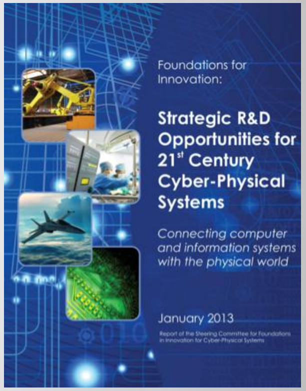


Build off of Technical Progress in Key Technical Challenge Areas



Leverage Industry & Government Vision and Investment in Cyber Physical Systems and the Industrial Internet





System-wide safety assurance envisions a continuum of information acquisition, analysis, and assessment that supports awareness and corrective action at levels appropriate to the threat potential on time scales appropriate to the nature of the threat

What is the Transformative Aeronautics Concept Program?

While mission programs focus on solving challenges, this program focuses on cultivating opportunities.

Seedling Program

Transformative Aeronautics Concept Program

Cultivates multi-disciplinary, revolutionary concepts to enable aviation transformation and harnesses convergence in aeronautics and non-aeronautics technologies to create new opportunities in aviation

Knocks down technical barriers and infuses internally and externally originated concepts into all six strategic thrusts identified by ARMD, creating innovation for tomorrow in the aviation system.

Provides flexibility for innovators to explore technology feasibility and provide the knowledge base for radical transformation.

Solicits and encourages revolutionary concepts

Creates the environment for researchers to become immersed in trying out new ideas

Performs ground and small-scale flight tests

Drives rapid turnover into new concepts

Projects

Leading Edge Aeronautics Research for NASA (LEARN)

Revolutionary Tools and Methods (RTM)

Convergent Aeronautics Solutions (CAS)

CAS project—overview

Focus on Big Challenges

Focus on major system level challenges that require NASA and the aviation community to think beyond current concepts, architectures and relationships

Maximize Economic Benefit of UAS

Can we safely and unobtrusively integrate UAS's into urban environments?

Zero-Emission Air Transportation

On-Demand Aviation

Develop Challenges with the Aviation Community

Conceive New Multi-Disciplinary Solutions

Multi-disciplinary NASA teams develop proposed new "convergent" solutions focused on proving feasibility and value of concepts

UAS Traffic Management Concept

Proposal for Rapid Feasibility with the UAS Community

Proposed Convergent Solutions

Fund Rapid Feasibility

ARMD funds 2 – 3 year feasibility R&D for the most promising and innovative solutions that have the potential to be game-changers for the aviation community.

Partnerships, Experimentation & Analysis for Feasibility

Review with Aviation Community / Transfer or Terminate

Feasibility efforts receive broad review by ARMD Mission Programs and the aviation community. Efforts are transferred into Mission Programs, out to the aviation community or are documented and terminated based on these reviews

Demonstration, Dissemination and Transfer

Sample "Big Questions"

For illustration only.

Big Question	Context	Strategic Thrust
Can we integrate UAS's in urban environments?	UAS can serve many missions and can be tailored t individual needs. One mission that UAS could potentially serve is the "last mile" problem in the delivery of goods and services; delivering individual packages from a distribution center, for example. Another mission could be localized aerial photography for real estate agents or wedding photographers. However, these missions require UAS to operate in low altitude and in the vicinity of the population. Urban areas are the most populous areas, and therefore would likely have high levels of demand. However, urban areas would also provide some of the most challenging integration challenges.	Autonomy for Aviation Transformation
Can we make a small airplane as easy to fly as a car is to drive, but as safe as commercial airline operations?	General aviation safety is still very poor despite many improvements in pilot displays and the implementation of significant automation. Safety is associated with high levels of pilot skill, which is hard for many to maintain when operating an aircraft in a non-professional capacity. Safety is generally attributed by the industry to be the major hurdle for greater utilization of general aviation aircraft in the transportation system.	Safe, Efficient Growth in Global Operations; Autonomy for Aviation Transformation

Foundational technologies & strategic thrusts

Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard

Ultra-Efficient Commercial Transports

- Pioneer technologies for big leaps in efficiency & environmental performance

Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology

Broadly Applicable/Broadly Critical Technologies – Applicable to Multiple Thrusts

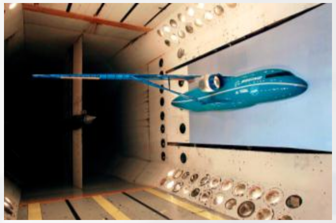
AS1.1 Physics-Based Turbulence Models & Simulations
AS2.1 High Temperature Materials for Turbine Engines

MDAO/Syst. Analysis
Combustion
Controls
Structures & Materials
Innovative Measurements

- Foundational research enables multiple Thrusts.
- Efforts provide discipline building blocks used in multi-disciplinary solutions.
- Technical Challenges can be developed and utilized for managing some foundational work.
- “Smaller” efforts are applied (not basic) research.

Foundational research key points

- Foundational research – when applied to key problems – is critical (i.e. not sand box or basic research)
- Important to maintain engagement with the external community for foundational research (CFD 2030 example)
- The conundrum: how to best align broadly-applicable, foundational research to strategic thrusts and to articulate the connection
- A work in progress: As we transition to a new structure - foundational research needs to play a strong role in the new TAC Program, but must maintain a strong connection to the other Programs.



Physics Based CFD-Tool Development applied to critical modeling problems

Committee finding

The Committee endorses the approach that NASA ARMD is taking to restructure their organization to not only continue research on relevant and critical aviation problems, but also to renew emphasis on activities focused on high-risk, forward thinking ideas. However, the Committee is concerned critical areas of aeronautics research may get “lost in the shuffle” as the restructure is implemented. The Committee finds that it is imperative for ARMD to maintain its commitment to both that foundational research which has always been at the core of the NASA Aeronautics mission and to continue its investment in Vertical Lift research and technology to enable U.S. leadership gains in this critical area of aeronautics.

Committee finding

The Committee would like to recognize the value of the work that NASA has supported through the Joint Planning and Development Office (JPDO). Funding for the JPDO was eliminated in the current appropriations and activities pursued by that organization are currently being integrated back into existing FAA organizations. The Committee encourages NASA to discuss with the FAA how best to continue the relevant strategic and forward looking aspects that were part of the JPDO.

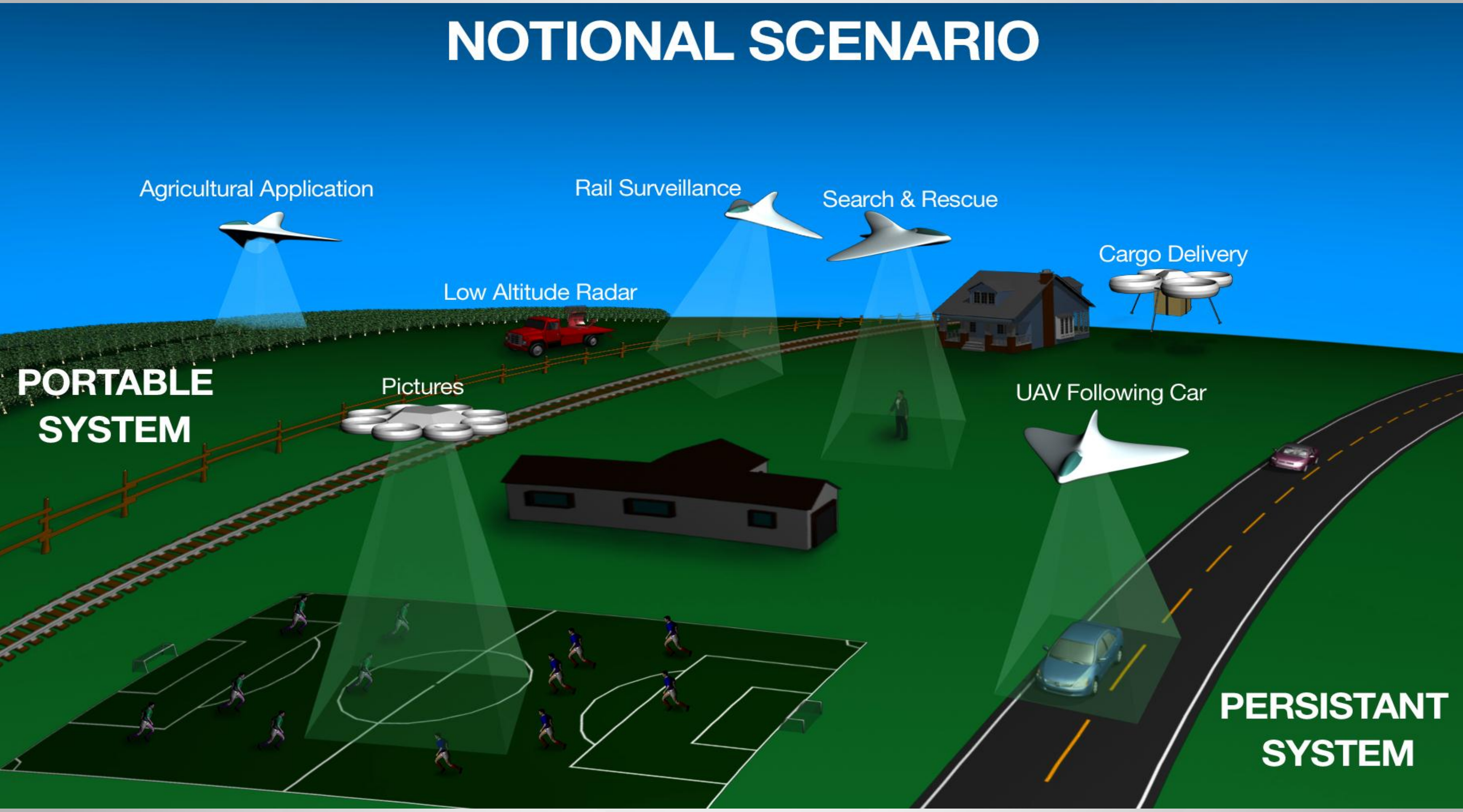
Committee finding

The Committee endorses NASA-DARPA collaboration on programs of mutual interest and advises that NASA engage DARPA leadership to identify and explore opportunities where commercial technology can benefit future military missions and/or where military technologies can benefit civil and commercial applications. Current technology areas of mutual interest may include hypersonic flight, autonomous/unmanned air systems, vertical lift technology, collaborative vehicle operations for enhanced airspace/mission management, and related data analysis tools.

Unmanned Aerial System (UAS) traffic management

- The Goal of UAS Traffic Management (UTM) is to enable safe and efficient low-altitude airspace and UAS operations
  - Many civilian applications of Unmanned Aerial System (UAS) are being considered
  - Many UAS will operate at lower altitude (Class G, 2,000 Feet)
  - No infrastructure to safely support these operations is available
  - Global interest (e.g., Australia, Japan, France, UK, Europe)
  - Lesson from History: Air Traffic Management (ATM) started after mid-air collision over Grand Canyon in 1956
  - Need to have a system for civilian low-altitude airspace and UAS operations

UTM applications



UTM concept development–status

PROGRESS
- Developed UTM vision document
- Defined initial UTM design characteristics
- Conducted on all-stakeholder workshop to gather feedback
  - 145 non-NASA stakeholder representatives

UTM WORKSHOP: KEY FINDINGS
- Overwhelmingly positive response
- Stakeholders support NASA's leadership and vision
- Many partners are ready to engage
- There is urgency to put a system in place

PARTNERSHIPS
- UAS manufacturers
- Online retailers
- Communication/navigation/surveilla nce providers
- System integrators
- Emerging UAS operators
- Cargo operators
- FAA, NOAA, DoD
- UAS test sites

Committee recommendation

Short Title of the Proposed Recommendation:

Unmanned Aerial System (UAS) Traffic Management (UTM)

Short Description of the Proposed Recommendation:

Many civilian applications of Unmanned Aerial Systems (UAS) have been imagined ranging from remote to congested urban areas, including goods delivery, infrastructure surveillance, agricultural support, and medical services delivery. However, key infrastructure to enable and safely manage widespread use of low-altitude (up to 2,000 feet in Class G) airspace and UAS operations therein does not exist. NASA is exploring concepts and technology development for a prototype UTM system. UTM will support safe and efficient UAS operations for the delivery of goods and services.

A number of partners have expressed an interest in working with NASA in exploring the research, development, prototyping, testing and possible implementation of the UTM system. Public-private-academia relationships are expected (and necessary) to help define and develop a UTM system. The Committee recommends that the NASA Administrator and all NASA organizations involved in the development and sustainment of agreements and partnerships be proactively engaged in reducing implementation barriers and provide any necessary tools to enable the innovative partnerships that will be required for the realization of UTM.

Committee recommendation

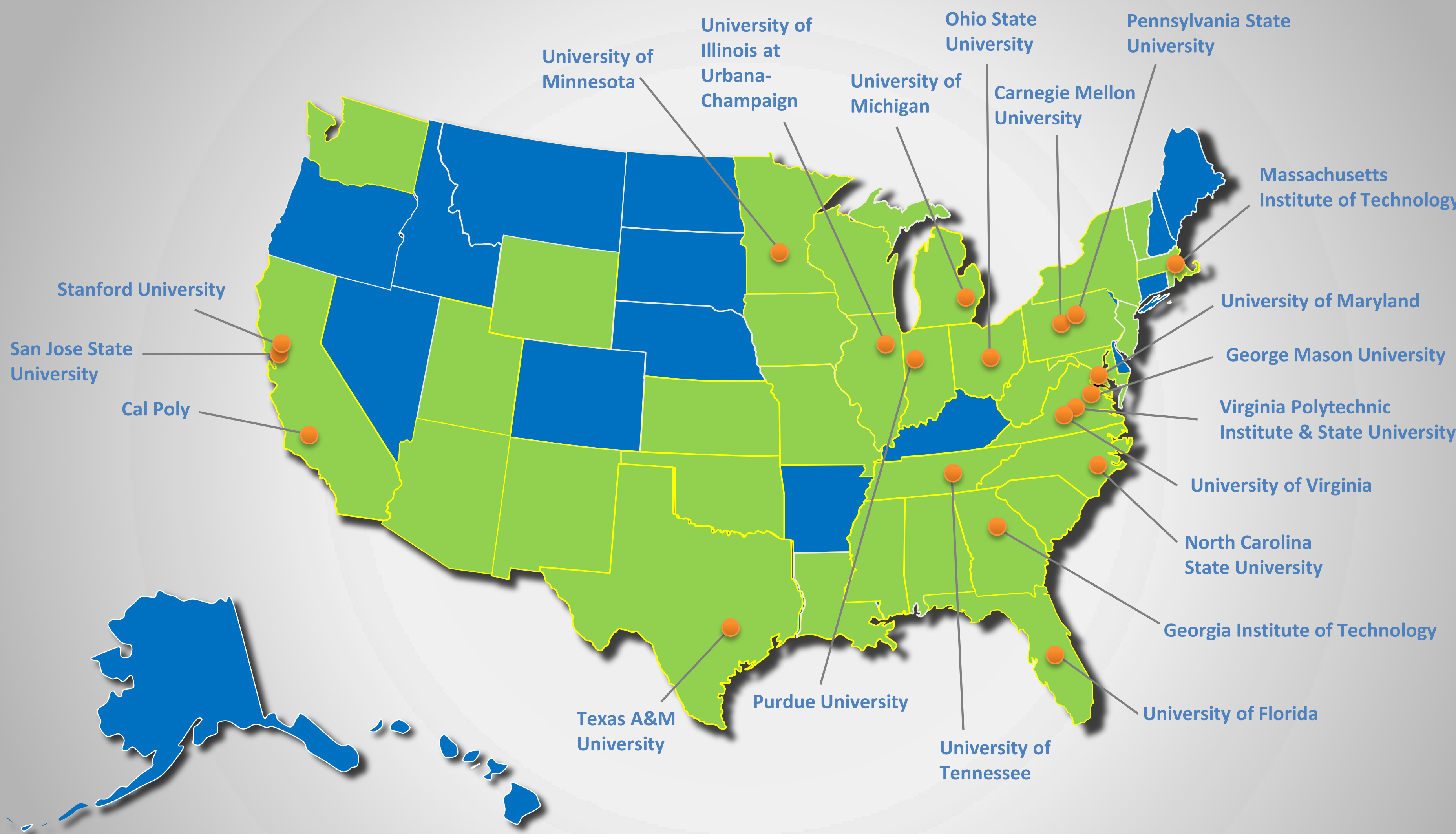
Major Reasons for Proposing the Recommendation:

The Committee is concerned that without sufficient support and focus from relevant NASA organizations, the agility and flexibility required for NASA to develop the complex UTM system will be compromised, leading to insufficient progress and ultimately impacting results. NASA should make this a high priority given the urgency warranted by such a system.

Consequences of No Action on the Proposed Recommendation:

Without sufficient Agency support of the innovative partnerships necessary for this activity, progress toward achieving this capability will be slow and potentially limited.

Diverse university engagement



University engagement

Principles

- Partner in Intellectual Capital
- Balanced Spectrum of Activities: Revolution, Innovation, Application, Education
- Strategically Managed, Sustained Relationships
- Competitively Engage a Wide Array of Colleges and Universities

Current Mechanisms for University Participation

- Research cooperative agreements, grants, or contracts competitively awarded through a NASA Research Announcement
- Aeronautics Scholars program

ARMD is seeking to enhance their interactions with universities and colleges to partner with NASA on the "big questions" as well as fundamental research